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MASS LOAD METHOD AND APPARATUS FOR A DATA STORAGE LIBRARY

BACKGROUND OF THE INVENTION

5   **1.   Field of the Invention:**

The present invention relates generally to data storage libraries and particularly to a method and apparatus for mass loading and unloading of data cartridges in a data storage library. Still more

10   particularly, the present invention relates to a data storage library that includes a walk-in customer access port that may be accessed by a user while the remainder of the library remains on-line and secure.

15   **2.   Background of the Invention:**

Automated data storage libraries incorporate one or more robotic mechanisms for moving data cartridges around within the library. From time to time, these robotic mechanisms require maintenance actions. Maintenance is

20   usually performed through a service door in the library's housing that allows personnel to access robotic mechanisms inside the library. Everything within the library, including all of the robotic mechanisms and tape drives, are shut down any time the service door is open.

25   This shut down is done for the safety of the personnel performing the maintenance on the robots.

The approach of shutting down the robotic mechanisms during maintenance is costly to the automated data storage library owner in terms of down time of the

30   library and security for the data within. The library

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can perform no useful work while the service door is open and all of the robots are shut down. Even if maintenance is required on only one robotic mechanism, the other robots must be stopped in order to avoid possible

5 collisions with the personnel. This means that no new data cartridges can be mounted into the read/write drives, and data cartridges currently in the read/write drives cannot be dismounted during maintenance operations.

10 In the prior art, there is a problem with permitting users access to a data storage library to easily load and unload large quantities of data cartridges into slots of a data storage library. Access to the library has been permitted by taking the library offline while the user

15 accesses the slots in the library.

Therefore, the current technology would be improved by a data storage library that includes a walk-in portion that may be accessed by a user while the remainder of the library remains on-line, secure, and accessible to a

20 robot that may continue to operate while a user is in the walk-in portion in order to permit loading and unloading of large quantities of tape cartridges.

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SUMMARY OF THE INVENTION

A data storage library is disclosed that provides a variable sized load/unload area within the library. The data storage library includes a housing defining an exterior and an interior region, storage slots disposed in the interior region for storing data cartridges, at least one barrier door, at least one front door, and a controller. The barrier door has a closed position for dividing the interior region into a first interior region and a second interior region. Thus, the interior region is divided into two regions when the barrier door is closed. The controller closes the barrier door prior to the front door being opened, and opens the barrier door only after the front door is closed. Thus, access is permitted to only the first interior region from the exterior region when the front door is opened. The first interior region is sized to permit a user to entirely physically enter the first interior region.

The above as well as additional objectives, features, and advantages of the present invention will become apparent in the following detailed written description.

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BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The

5 invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

10 **Figure 1** is a perspective view that depicts a data storage library having its front door opened and barrier door closed in accordance with the present invention;

Figure 2 is a top view of the data storage library of **Figure 1** having a barrier door in the opened position

15 in accordance with the present invention;

Figure 3 is a top view of the data storage library of **Figure 1** having a barrier door in the closed position to define a load/unload area of a first size in accordance with the present invention;

20 **Figure 4** is a top view of the data storage library of **Figure 1** having a barrier door in the closed position to define a load/unload area of a second size and including a second barrier door in accordance with the present invention;

25 **Figure 5** is a partial top view of the data storage library of **Figure 1** depicting the barrier door movement mechanism in more detail in accordance with the present invention;

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Figure 6 illustrates a high level flow chart that depicts a process for providing a variable size load/unload area of a data storage library in accordance with the present invention; and

5   **Figure 7** depicts a block diagram of a computer system that may be used to implement a controller for the data storage library of **Figure 1** in accordance with the present invention.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is a mass load method and
apparatus for a data storage library. The data storage
5 library includes a housing that has an interior region
that is secured from its exterior region by a front door.
Within the interior region are a plurality of storage
slots that may be used to store data cartridges. The
interior region of the housing may be divided into a
10 first region and a second region by a barrier door when
the barrier door is closed. A large first number of the
storage slots will be located in the first region and a
second number of the storage slots will be located in the
second region when the barrier door is closed.

15 The barrier door is closed prior to the front door
being opened. When the front door is open and the
barrier door is closed, the first region is accessible to
a user as a customer access port. A user may fully enter
the first region. Thus, the first region is sized to
20 permit an entire human body to enter the first region.

While the front door is opened and the barrier door
is closed, the data storage library remains online. The
robot is located in the second region while the front
door is opened and the barrier door is closed. Thus, the
25 robot may continue to access the second number of slots
in the second region while a user is physically within
the first region accessing the first number of slots.

Figure 1 is a perspective view that depicts a data
storage library 100 in accordance with the present
30 invention. Data storage library 100 provides a variable

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sized load/unload area **102** within library **100**. Data storage library **100** includes a housing **104** that defines an exterior region **106** and an interior region **108**. Storage slots **110** are disposed in interior region **108** for storing data cartridges. Data storage library **100** also includes a barrier door **112** (shown in its closed position), a front door **114**, and a controller **118**.

The barrier door may be a sliding, rotating, louvered, bifold, telescoping, tambour, or any other type of door.

Data storage library **100** includes a plurality of slots **110** with library **100**. Each slot may be used to store a single data cartridge. A robot (shown in **Figures 2-5**) is included within library **100**. When library **100** is online, the robot may move within the interior **108** of the library in order to access and/or move various data cartridges without user involvement. The robot may move within interior region from one end toward another until it meets a barrier. When barrier door **112** is opened, the robot will continue to move until it meets front door **114**. When barrier door **112** is closed, the robot will continue to move until it meets barrier door **112**.

Library **100** includes a front door **114** which may be opened to permit access from exterior region **106** into interior region **108**. Slots **110** are stationary and fixed within library **100**.

Figure 2 depicts a top view of the data storage library of **Figure 1** having a barrier door **112** in the opened position in accordance with the present invention.

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Library 100 includes a front door 114 that may be opened
in order to permit access to the library's slots 110.

Library 100 consists of a plurality of storage slots
110 mounted in an interior region 108 of housing 104. One

5   or more robotic mechanisms, such as robot 200, operate
within interior housing in order to move the data
cartridges about within library 100. Tape drives 120 are
included within library 100 in order to read the various
data cartridges.

10   Library control unit 118 provides control and
coordination of robot 200 as well as opening and closing
of the front 114 and barrier 112 doors as well as the
adjustment of the barrier door 112 from one end of
interior region 108 to the other. Barrier door 112 may

15   be moved when it is in the opened position within
interior region 108 from one location to another.

When library 100 is online with the front door 114
closed and barrier door 112 opened, robot 200 moves back
and forth along guide track 201 within library 100 from

20   one end 202 of interior region 108 to the other end 204
while slots 110 remain stationary. All slots 110 may be
accessed by robot 200 when front door 114 is closed and
barrier door 112 is opened.

Figure 3 illustrates a top view of the data storage

25   library 100 of Figure 1 having barrier door 112 in the
closed position to define a load/unload area of a first
size in accordance with the present invention. When
barrier door 112 is closed, a load/unload area 220 is
defined between one end 202 of library 100 and barrier

30   door 112. Thus, barrier door 112 divides interior region

108 into a first region **206** and a second region **208**.
First region **206** is an area **220** that may be used by a
person to load and unload data cartridges from the slots
that are included in area **220**. A large number of slots

5   are included in area **220** so that a user may load and/or
unload a large number of slots at one time. First region
206 is large enough to permit a human being to entirely
enter first region **206**.

The size of load/unload area **220**, and thus first

10   region **206**, may be specified by a user or may be a
predefined default size. When barrier door **112** is
closed, robot **200** may move within second region **208** of
library **100** between a new end **224** defined by barrier door
112 and end **204**.

15   When a person wishes to enter library **100**, a user
enters a command using controller **118** to open front door
114. In response to a receipt of this command,
controller **118** causes robot **200** to move into region **208**,
close barrier door **112**, and then open front door **114**.

20   While barrier door **112** is closed, the person may enter
region **220** to access the slots in region **220**. Also while
barrier door **112** is closed, library **100** remains online,
and the robot may continue to operate within region **208**
to access the slots in region **208**.

25   A user may also define a particular location within
library **100** at which to close barrier door. When a
particular location is defined, controller **118** will cause
barrier door **112** to move to the particular location prior
to closing barrier door **112**. **Figure 3** depicts barrier

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door **112** being closed at a first location within library **100**.

 Figure 4 depicts a top view of the data storage library of **Figure 1** having a barrier door in the closed
5 position to define a load/unload area of a second size in accordance with the present invention. **Figure 4** also depicts a second barrier door that may or may not be included within library **100**.

 When barrier door **112** is closed in a second location
10 (as depicted by **Figure 4**), interior region **108** is divided into a first region **300** and second region **302**. Thus, load/unload area **220** is a second size. Load/unload area **220** is now defined between one end **202** of interior region **108** and barrier door **112**. When barrier door **112** is
15 closed, robot **200** may move within second interior region **302** between a new end **304** defined by barrier door **112** and end **204**.

 According to another embodiment, a second barrier door **310** may be included within library **100** for dividing
20 interior **108** into additional regions. Barrier doors **112** and **310** are shown in their closed positions. When a second barrier door is included, barrier doors **112** and **310** thus create three regions, **312**, **314**, and **316**, when they are closed. The present invention may be utilized
25 to block robot **200** from entering regions **312** and **314** when both barrier doors are closed, or may be used to block robot **200** from only region **312**, as depicted by **Figure 4**. Alternatively, robot **200** may be confined within region **314** when both barrier doors are closed.

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Figure 5 is a partial top view of the data storage library of **Figure 1** depicting the barrier door movement mechanism in more detail in accordance with the present invention.

5   A first drive motor **400** provides mechanical power to move barrier door **112** along guide track **402** within interior region **108**. In this manner, barrier door **112** may be moved parallel to a side **403** of housing **104** to any position within housing **104**. A second drive motor **404**

10   provides mechanical power to open and close barrier door **112** perpendicularly to side **403** along guide track **406**. When a user specifies a location at which to close barrier door **112**, motor **400** moves barrier door **112**, while barrier door **112** is in its open position, horizontally

15   through library **100** to the specified location. Once barrier door **112** arrives at the specified location, motor **404** then closes barrier door **112**. The slots are positioned within library **100** in such a manner so that barrier door **112** may be moved while it is in its opened

20   positioned horizontally along side wall **403**.

Both doors **112** and **114** may be controlled by a user through library control unit **118** either directly or indirectly. A user may control a drive motor directly by entering specific motor control instructions into the

25   library control unit **118**. A user may control a motor indirectly by entering into the library control unit **118** a command to open front door **114**. Another drive motor may be provided to automatically open and close front door **114**. In response to a command to open front door

30   **114** when three motors are provided, library control unit

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118 will move barrier door **112** to the specified horizontal location within interior **108** using motor **404**, and then close the barrier door **112** using motor **404** and open front door **114** using another motor (not shown).

5   The present invention may be implemented with any number of motors. A combination of motor and manual cranks may also be utilized.

Figure 6 illustrates a high level flow chart that depicts a process for providing a variable size

10   load/unload area of a data storage library in accordance with the present invention. The process starts as depicted by block **600** and thereafter passes to block **602** which illustrates the data storage library being brought online with the front door closed and the barrier door

15   opened. The robot is permitted to access the entire interior region of the library when the front door is closed and the barrier door is opened. Next, block **604** depicts a determination of whether or not a command to open the front door has been received. If a

20   determination is made that a command to open the front door has not been received, the process passes back to block **604**. If a determination is made that a command to open the front door has been received, the process passes to block **606** which illustrates prompting a user to enter

25   a desired size of a load/unload area. The user could specify a size by specifying a particular number of slots to be made accessible, specify a particular physical size for the area, or by specifying a particular location or a particular guide rail to use when closing the barrier

30   door.

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The process then passes to block **608** which depicts determining a placement location for closing the barrier door in order to create either the size specified by the user or a default size. Next, block **610** illustrates the

5   library moving its robot outside of the defined load/unload area. Thereafter, block **612** depicts closing the barrier door at the determined placement location in order to create a load/unload area that is either the specified or default size. Thus, once the barrier door

10   is closed, the interior region is divided into a first interior region that is the load/unload area, and a second interior region. The robot is located within the second interior region when the barrier door is closed.

     The process then passes to block **614** which

15   illustrates opening the front door. Next, block **616** depicts the library remaining online while the front door is open and the barrier door is closed. The robot may continue to access slots in the second interior region while the front door is open and the barrier door is

20   closed. Block **618**, then, illustrates a determination of whether or not a command to close the front door has been received. If a determination is made that a command to close the front door has not been received, the process passes back to block **618**. If a determination is made

25   that a command to close the front door has been received, the process passes to block **620** which depicts closing the front door. Next, block **622** illustrates opening the barrier door. Block **624**, then, depicts the library remaining online with the front door closed, the barrier

30   door opened, and the robot once again being permitted to

access all of the interior region of the library. The
process then passes back to block **604**.

 Figure 7 depicts a block diagram of a computer
system that may be used to implement a controller for the
5 data storage library of **Figure 1** in accordance with the
present invention. Data processing system **700** may be a
symmetric multiprocessor (SMP) system including a
plurality of processors **702** and **704** connected to system
bus **706**. Alternatively, a single processor system may be
10 employed. Also connected to system bus **706** is memory
controller/cache **708**, which provides an interface to
local memory **709**. I/O bus bridge **710** is connected to
system bus **706** and provides an interface to I/O bus **712**.
Memory controller/cache **708** and I/O bus bridge **710** may be
15 integrated as depicted.

 Peripheral component interconnect (PCI) bus bridge
714 connected to I/O bus **712** provides an interface to PCI
local bus **716**. A number of modems may be connected to
PCI bus **716**. Typical PCI bus implementations will
20 support four PCI expansion slots or add-in connectors.

 Additional PCI bus bridges **722** and **724** provide
interfaces for additional PCI buses **726** and **728**, from
which additional modems or network adapters may be
supported. In this manner, data processing system **700**
25 allows connections to multiple network computers. A
memory-mapped graphics adapter **730** and hard disk **732** may
also be connected to I/O bus **712** as depicted, either
directly or indirectly.

 Those of ordinary skill in the art will appreciate
30 that the hardware depicted in **Figure 7** may vary. For

example, other peripheral devices, such as optical disk drives and the like, also may be used in addition to or in place of the hardware depicted. The depicted example is not meant to imply architectural limitations with

5 respect to the present invention.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those of ordinary skill in the art will appreciate that the processes of

10 the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of the particular type of signal bearing media actually used to carry out the

15 distribution. Examples of computer readable media include recordable-type media, such as a floppy disk, a hard disk drive, a RAM, CD-ROMs, DVD-ROMs, and transmission-type media, such as digital and analog communications links, wired or wireless communications

20 links using transmission forms, such as, for example, radio frequency and light wave transmissions. The computer readable media may take the form of coded formats that are decoded for actual use in a particular data processing system.

25 The description of the present invention has been presented for purposes of illustration and description, and is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in

30 the art. The embodiment was chosen and described in

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order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are

5 suited to the particular use contemplated.